

## CLAIMS

What is claimed is:

1. A supervisory command and data acquisition (SCADA) system to manage a wind farm comprising:

a plurality of turbine communication servers (TCSs) within wind turbines of the wind farm to collect data from the turbines and to store a first subset of the data locally and to transmit the first subset of data according to non-real-time intervals and to transmit a second subset of data over a wind farm network to provide approximately real-time data, wherein the second subset of data is stored until successfully transferred; and

a server coupled to communicate with the plurality of TCSs to provide signals to control the wind turbines, the server being further to store data received from the plurality of TCSs and to perform database management on the received data.

2. The system of claim 1 wherein the non-real-time intervals comprise one of: a predetermined time interval, in response to a request from the server, or occurrence of a predetermined set of conditions.

3. The system of claim 1 further comprising a substation command and acquisition unit (SCAU) located at a substation and coupled with the server to collect data from the substation and to store a first subset of the data locally and to transmit the first subset of data according to non-real-time intervals and to transmit a second subset of data over the wind farm network to provide approximately real-time data, wherein the second subset of data is stored until successfully transferred.

4. The system of claim 3 further comprising a meteorological command and acquisition unit (MCAU) located a meteorological site to collect meteorological data from sensors at the meteorological site to transmit the first subset of data according to non-real-time intervals and to transmit a second subset of data over the wind farm network to provide approximately real-time data, wherein the second subset of data is stored until successfully transferred.

5. The system of claim 4, wherein the meteorological site has a meteorology tower with sensors to monitor horizontal wind speed and direction from at least four levels above the ground, vertical wind speed, temperature, and atmospheric pressure.

6. The system of claim 5, wherein the MCAU comprises a computer system running a general purpose operating system, and further wherein the MCAU executes a client application providing local data collection and site control.

7. The system of claim 4, wherein one or more of the TCSs are configured to provide a connection for a portable device to allow a user of the portable device to communicate with one or more of the plurality of TCSs, the MCAU and/or the SCAU.

8. The system of claim 1 wherein the first subset of data is transmitted according to a first protocol and the second subset of data is transmitted according to a second protocol.

9. The system of claim 1, further comprising a graphical user interface (GUI) that can be accessed through a connection to one of the plurality of TCSs, the MCAU and/or the SCAU.

10. The system of claim 9, wherein the user interface provides views to of the plurality of TCSs, the MCAU and/or the SCAU to allow users access to real time data and subsystem controls.

11. The system of claim 1, wherein one or more of the plurality of TCSs is configured to store data locally for a period of time sufficient to bridge anticipated unavailability of the server.

12. The system of claim 1, wherein one or more of the plurality of TCSs is configured to collect data including wind turbine controller state, wind speed, energy levels, and alarms.

13. The system of claim 1, wherein one or more of the plurality of TCSs comprises a computer system running a general purpose operating system, and further wherein each of the one or more TCSs executes a client application providing local data collection and site control.

14. A system for managing a wind farm having a plurality of wind turbines comprising:

a Supervisory Command and Data Acquisition (SCADA) element at each wind turbine to collect data from the respective wind turbines;

a SCADA element at each of one or more meteorological sites to collect meteorological data;

a SCADA element at each of one or more substations electrically connected with the plurality of wind turbines; and

a server coupled to communicate with the wind turbine, meteorological, and substation SCADA elements to receive and to store data received from the elements at predetermined intervals and to perform database management on the received data, the server further to gather and maintain current and historical data as to the inputs, operating conditions, and outputs of the plurality of wind turbines.

15. The system of claim 14, wherein the gathered data comprises wind speed and energy production gathered from each wind turbine according to a first predetermined interval, meteorological data gathered from each meteorological site according to a second predetermined interval and substation data including power production each substation.

16. The system of claim 14, wherein the gathered data comprises power, reactive power, wind speed, energy subtotal, and total energy data gathered according to a first time interval.

17. The system of claim 16, wherein the gathered data further comprises generator rotational speed, generator temperature, gearbox temperature, ambient temperature, wind speed, wind direction, real power, reactive power, power factor, phase voltage and phase current for each phase, energy production, and production time.

18. The system of claim 15, wherein the gathered data comprises controller state gathered from each wind turbine, vertical and horizontal wind speeds, wind direction, temperature, and air pressure, total active energy out from the substation, total reactive energy out from the substation, total active energy into the substation, and total reactive energy into the substation.

19. The system of claim 14, wherein the wind farm is organized into parks for reporting and management purposes and the gathered data comprises energy produced by each park.

20. The system of claim 19, wherein the data for each park comprises an operational status of one or more turbines in the park, total real power produced in the park, total reactive power produced in the park, and/or a power factor for the park.

21. The system of claim 14, further comprising a configuration database for the wind farm to store information describing a current configuration of systems elements to be used during system initialization comprising information describing the current

configuration of the wind farm including the wind turbine SCADA elements in the wind farm.

22. The system of claim 21, the configuration information further comprising: information describing each wind turbine of the wind farm, including for each such turbine data source information describing how source data from the turbine is to be mapped to fields in a system database.

23. The system of claim 14, further comprising processing logic to process wind turbine data to report average power production over a time window, expected power production over the time window, and/or production efficiency over the time window for each wind turbine in the wind farm.

24. The system of claim 14, wherein the wind farm is organized into parks and the system further comprises processing logic to wind turbine data to report average power production over a time window, expected power production over the time window, and/or production efficiency over the time window for each wind turbine in each park.